

What is claimed is:

1. An apparatus for carrier frequency offset compensation at a receiver of a communication system, wherein a symbol signal modulated by a carrier is transmitted via a plurality of subchannels, wherein the symbol signal comprises a pilot signal and the subchannels comprise at least a pilot subchannel for transmitting the pilot signal, the apparatus comprising:
 - a pilot subchannel estimator for generating an estimated frequency response of the pilot signal;
 - a frequency offset estimator, coupled to the pilot subchannel estimator, for generating an estimated carrier frequency offset according to a phase error of the estimated frequency response of the symbol signal and a following symbol signal;
 - a phase accumulator, coupled to the frequency offset estimator, for calculating an accumulated phase rotation according to the estimated carrier frequency offset; and
 - a phase rotator, coupled to the phase accumulator, for carrier frequency offset compensation according to the accumulated phase rotation.
2. The apparatus of claim 1, wherein the phase rotator for carrier frequency offset compensation is executed in time-domain.
3. The apparatus of claim 1, wherein the phase rotator for carrier frequency offset compensation is executed in frequency-domain.
4. The apparatus of claim 1, wherein if the subchannels comprise a plurality of the pilot subchannels for transmitting a plurality of pilot signals, then the pilot subchannel estimator is for generating a plurality of estimated frequency responses corresponding to the pilot signals, and the frequency offset estimator coupled to the pilot subchannel estimator is for generating an estimated carrier frequency offset according to the estimated frequency responses of one of the pilot signals of the symbol signal and that of a corresponding pilot signal of a following symbol signal.

5. The apparatus of claim 4, wherein the estimated carrier frequency offset is generated through generating a plurality of phase errors, wherein each of the phase errors is generated according to the estimated frequency response of one of the pilot signals of the symbol signal and that of a corresponding pilot signal of the following symbol signal, and then averaging the phase errors.
6. An apparatus for phase compensation at a receiver of a communication system, wherein a symbol signal modulated by a carrier is transmitted via a plurality of subchannels, wherein the symbol signal comprises a pilot signal and the subchannels comprise at least a pilot subchannel for transmitting the pilot signal, the apparatus comprising:
- a carrier frequency offset compensator to perform a carrier frequency offset compensation on the symbol signal;
 - a channel compensator to perform a channel compensation on the symbol signal;
 - a phase error estimator for extracting the pilot signal and generating an estimated residual phase error between the extracted pilot signal and an original pilot signal;
 - a buffer for storing the estimated residual phase error; and
 - a phase rotator, coupled to the buffer, for compensating a following symbol signal according to the estimated residual phase error.
7. The apparatus of claim 6, wherein the following symbol signal is compensated by the channel compensator before being compensated by the phase rotator.
8. The apparatus of claim 6, wherein if the subchannels comprise a plurality of the pilot subchannels for transmitting a plurality of pilot signals, then the phase error estimator is for generating the estimated residual phase error through extracting the pilot signals, generating a plurality of estimated residual phase errors between each of the extracted pilot signal and a corresponding original pilot signal, and averaging the estimated residual phase errors.
9. An apparatus for phase compensation at a receiver of a communication

system, wherein a symbol signal modulated by a carrier is transmitted via a plurality of subchannels, wherein the symbol signal comprises at least a pilot signal and at least a data signal, and the subchannels comprise at least a pilot subchannel for transmitting the pilot signal and at least a data subchannel for transmitting the data signal, the apparatus comprising:

a carrier frequency offset compensator to perform a carrier frequency offset compensation on the symbol signal;

a buffer for storing the symbol signal after carrier frequency offset compensation;

a pilot subchannel compensator, coupled to the buffer, for compensating the pilot signal to generate a channel-compensated pilot signal;

a phase error estimator, coupled to the pilot subchannel compensator, for generating an estimated residual phase error between the channel-compensated pilot signal and an original pilot signal ; and

a phase rotator for compensating the data signal according to the estimated residual phase error.

10. The apparatus of claim 9, wherein the data signal is compensated by a data subchannel compensator before being compensated by the phase rotator.

11. The apparatus of claim 9, wherein if the subchannels comprise a plurality of the pilot subchannels for transmitting a plurality of pilot signals, the phase error estimator generates the estimated residual phase error by generating a plurality of estimated residual phase errors between each of the extracted pilot signal and a corresponding original pilot signal, and averaging the estimated residual phase errors.

12. A compensating module at a receiver of a communication system, wherein a symbol signal modulated by a carrier is transmitted via a plurality of subchannels, wherein the symbol signal comprises at least a pilot signal and at least a data signal, and the subchannels comprise at least a pilot subchannel for transmitting the pilot signal and at least a data subchannel for transmitting the data signal, the compensating module comprising:

a frequency offset compensator to perform a frequency offset

compensation on the symbol signal according to an estimated frequency response of the pilot subchannel transmitting the pilot signal; and

5 a phase compensator to perform a phase compensation on the frequency offset compensated symbol signal according to an estimated residual phase error of the pilot signal.

13. The compensating module of claim 12, wherein the frequency offset compensator is to compensate the symbol signal in frequency-domain.

10 14. The compensating module of claim 12, wherein the frequency offset compensator is to compensate the symbol signal in time-domain.

15. The compensating module of claim 12, wherein the frequency offset compensator comprises:

a pilot subchannel estimator for generating the estimated frequency response of the pilot signal ;

15 a frequency offset estimator, coupled to the pilot subchannel estimator, for generating the estimated carrier frequency offset according to the phase error between the estimated frequency response of the pilot signal of the symbol signal and the estimated frequency response of the pilot signal of a following symbol signal;

20 a phase accumulator, coupled to the frequency offset estimator, for calculating an accumulated phase rotation according to the estimated carrier frequency offset; and

25 a phase rotator, coupled to the phase accumulator, for performing frequency offset compensation according to the accumulated phase rotation.

16. The compensating module of claim 12, wherein the phase compensator comprises:

30 a phase error estimator for extracting the pilot signal of the frequency offset compensated symbol signal, and generating the estimated residual phase error between the extracted pilot signal and an original pilot signal transmitted by the transmitter ;

a buffer for storing the estimated residual phase error; and

a phase rotator, coupled to the buffer, for compensating a following frequency offset compensated symbol signal according to the estimated residual phase error.

5 17. The compensating module of claim 12, wherein the phase compensator comprises:

a buffer for storing the frequency offset compensated symbol signal;

10 a pilot subchannel compensator, coupled to the buffer, for compensating the pilot signal of the frequency offset-compensated symbol signal to generate a channel-compensated pilot signal;

a phase error estimator, coupled to the pilot subchannel compensator, for generating an estimated residual phase error between the channel-compensated pilot signal and an original pilot signal transmitted by the transmitter ; and

15 a phase rotator for compensating the data signal of the frequency offset-compensated symbol signal according to the estimated residual phase error.

20 18. The compensating module of claim 12, wherein the compensating module further comprises a channel compensator to perform a channel compensation on the frequency offset compensated symbol signal.

19. The compensating module of claim 12, wherein the phase compensator comprises:

a data buffer for storing the data signal of the frequency offset-compensated symbol signal;

25 a pilot subchannel compensator, coupled to the pilot subchannel estimator, for compensating the pilot signal of the frequency offset-compensated symbol signal and for generating a channel-compensated pilot signal;

30 a phase error estimator, coupled to the pilot subchannel compensating device, for generating an estimated residual phase error between the channel-compensated pilot signal and an original pilot signal

transmitted by the transmitter; and

a first phase rotator, coupled to the phase error estimator and the data buffer, for compensating the data signal of the frequency offset-compensated symbol signal according to the estimated residual phase error.

20. A method for carrier frequency offset compensation used at a receiver of a communication system, wherein a symbol signal modulated by a carrier is transmitted via a plurality of subchannels, wherein the symbol signal comprises at least a pilot signal and the subchannels comprise at least a pilot subchannel for transmitting the pilot signal, the method comprising:

generating an estimated frequency response of the pilot signal;

determining a phase error according to the estimated frequency response of the pilot signal of the symbol signal and the estimated frequency response of the pilot signal of a following symbol signal;

generating an estimated carrier frequency offset according to the phase error;

calculating an accumulated phase rotation according to the estimated carrier frequency offset; and

performing carrier frequency offset compensation according to the accumulated phase rotation.

21. The method of claim 20, wherein the carrier frequency offset compensation is performed on a frequency-domain symbol signal.

22. The method of claim 20, wherein the carrier frequency offset compensation is performed on a time-domain symbol signal.

23. The method of claim 20, wherein if the subchannels comprise a plurality of the pilot subchannels for transmitting a plurality of pilot signals, the method comprises: generating a plurality of estimated frequency responses of the pilot signals; and generating an estimated carrier frequency offset according to the estimated frequency responses of the pilot signals of the symbol signal and the estimated frequency responses of the pilot signals of a following symbol signal.

25. The method of claim 24, wherein the estimated carrier frequency offset is generated through generating a plurality of phase errors, wherein each of the phase errors is generated according to the estimated frequency response of one of the pilot signals of the symbol signal and the estimated frequency response of a corresponding pilot signal of the following symbol signal, and then averaging the phase errors.

26. A method for phase compensation used at a receiver of a communication system, wherein a symbol signal modulated by a carrier is transmitted via a plurality of subchannels, wherein the symbol signal comprises at least a pilot signal and at least a data signal, and the subchannels comprise at least a pilot subchannel for transmitting the pilot signal and at least a data subchannel for transmitting the data signal, the method comprising:

extracting the pilot signal;

generating an estimated residual phase error between the extracted pilot signal and an original pilot signal transmitted by the transmitter; and

compensating a following symbol signal according to the estimated residual phase error.

27. The method of claim 26, wherein if the subchannels comprise a plurality of the pilot subchannels for transmitting a plurality of pilot signals, the estimated residual phase error is generated through extracting the pilot signals, generating a plurality of estimated residual phase errors between each of the extracted pilot signal and a corresponding original pilot signal, and averaging the estimated residual phase errors.

28. A method for phase compensation used at a receiver of a communication system, wherein a symbol signal modulated by a carrier is transmitted via a plurality of subchannels, wherein the symbol signal comprises at least a pilot signal and at least a data signal, and the subchannels comprise at least a pilot subchannel for transmitting the pilot signal and at least a data subchannel for transmitting the data signal, the method comprising:

storing the symbol signal;

extracting and compensating the pilot signal to generate a

channel-compensated pilot signal;

generating an estimated residual phase error between the channel-compensated pilot signal and an original pilot signal transmitted by the transmitter; and

5 extracting and compensating the data signal according to the estimated residual phase error.

29. The method of claim 28, wherein the method further comprises performing a channel compensation on the symbol signal before performing compensation according to the estimated residual phase error on the data
10 signal.

30. The method of claim 28, wherein if the subchannels comprise a plurality of pilot subchannels for transmitting a plurality of pilot signals, the method comprises: generating a plurality of phase errors, wherein each of the phase errors is determined according to one of the pilot signals and a
15 corresponding original pilot signals; and averaging the phase errors.